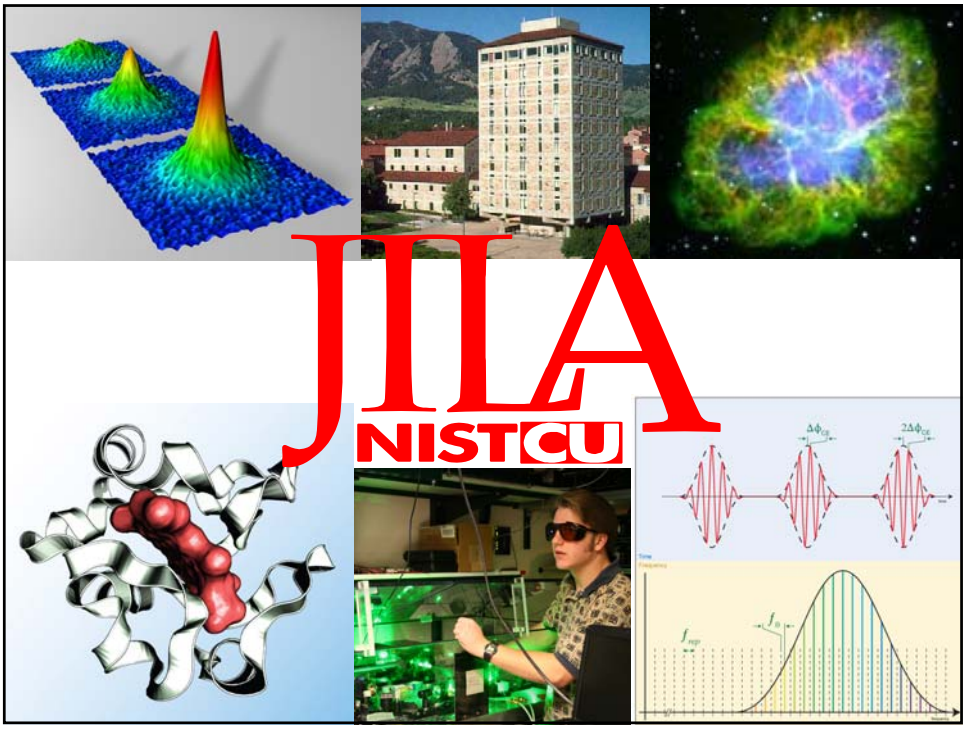
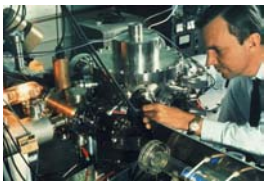


What is JILA?

JILA

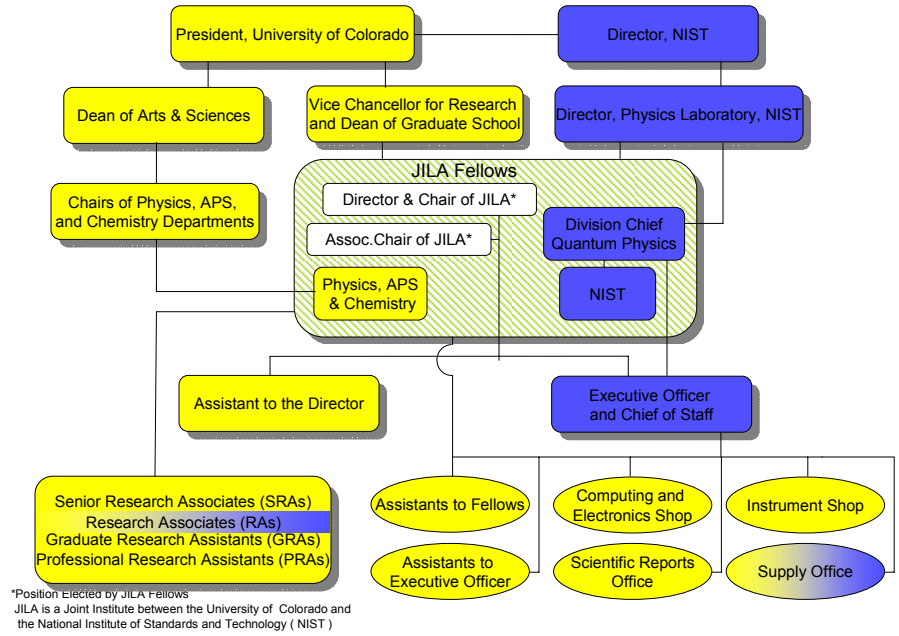
- JILA is a joint research institute between NIST and the University of Colorado
- Physically located on the University campus
- NIST JILA Fellows hold "Adjoint" Faculty status with the University and CU)
- 28 JILA Fellows (NIST
- Approximately 250 personnel total including Fellows, Research Associates, students (graduate and undergraduate) and staff

History



- Founded as the “Joint Institute for Laboratory Astrophysics” in 1962
- Founding group of JILA Fellows led by Lewis Branscomb
- “Laboratory Astrophysics” never quite “jelled”
  - Although both Astrophysicists and laboratory science are still present
- Name changed to just “JILA” in early 1990s (motivated in part by NBS → NIST)
- Today JILA is known as a leading center for
  - Atomic, Molecular and Atomic (AMO) Science
  - Measurement Science

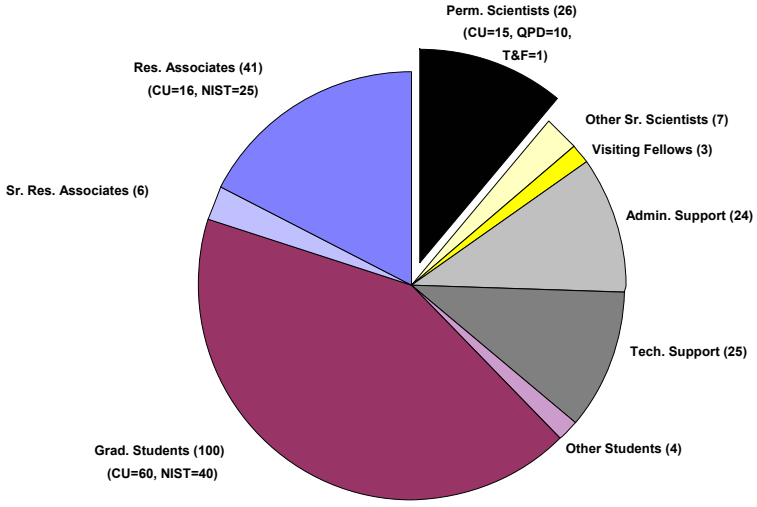
JILA Organizational Chart



*Position Elected by JILA Fellows

JILA is a Joint Institute between the University of Colorado and the National Institute of Standards and Technology (NIST)

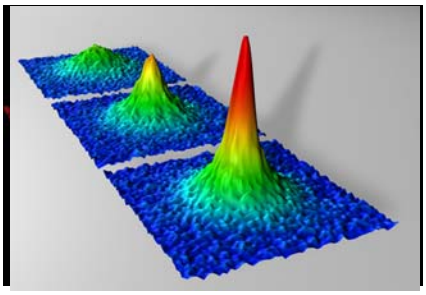
Staffing

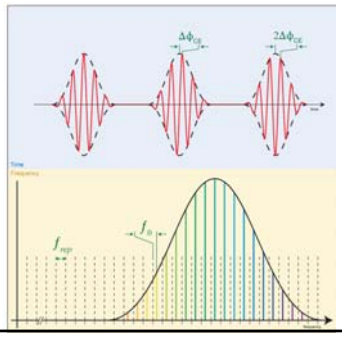


2004 Data

Strengths

- JILA is leader in the field of cold atoms
  - First Bose-Einstein condensate (1995)
  - First Fermi condensate (2002)
- Control of atoms with light built on measurement science expertise
- Leader in precision optical frequency metrology
  - 1970's speed-of-light → redefinition of meter
  - 2000's optical frequency combs





Recognition

- 6 JILA Fellows are members of the National Academy of Science
- Many Awards including
  - 2 MacArthur Fellows
  - 2001 Nobel Prize in Physics (Cornell and Wieman)
  - 2005 Nobel Prize in Physics (Hall)



JILA is a unique training ground for NIST

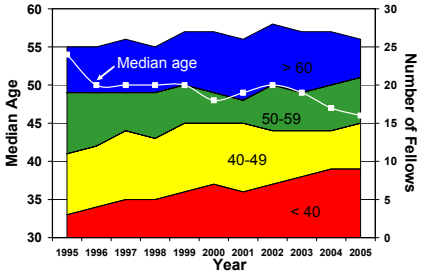
Barger, Dick
Beaty, Earl
Bergquist, Jim
Branscomb, Lewis
Burke, Jim
Burnett, Keith
Byerly, Rad
Callicoat, Bert
Celotta, Bob
Chamberlain, George
Claussen, Neil
Clement, Tracy
Cornell, Eric
Corwin, Kristan
Davis, Scott
DeMarco, Brian
Diddams, Scott
Donnelly, Elizabeth
Dowell, Marla
Drullinger, Bob
Dunn, Gordon
Evans, John
Faller, Jim

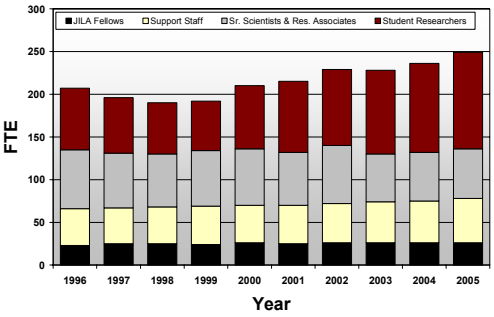
Gallagher, Alan
Gallagher, Jean
Gebbie, Katharine
Gilbert, Sarah
Hall, John
Hammond, James
Heavner, Tom
Hollberg, Leo
Jefferts, Steve
Jelenkovic, Brana
Jin, Debbie
Jones, Mike
Jones, Richard
Kelleher, Daniel
Kieffer, Lee
Levine, Judah
Lykke, Keith
Magyar, John
Mirowski, Elizabeth
Mitchell, Jeffrey
Monroe, Chris
Myatt, Chris
Nadal, Maria

Nesbitt, David
Newbury, Nate
Newell, David
Norcross, David
Oates, Chris
Patrick, Heather
Plusquellic, David
Ramond, Tanya
Roberts, Jacob
Robinson, Hugh
Rumble, John
Schlager, John
Shwarz, Joshua
Silverman, Kevin
Sinnott, George
Stephens, Michelle
Van Brunt, Richard
Vogel, Kurt
Walls, Fred
Williams, Ed
Wood, Chris
Ye, Jun

Renewal

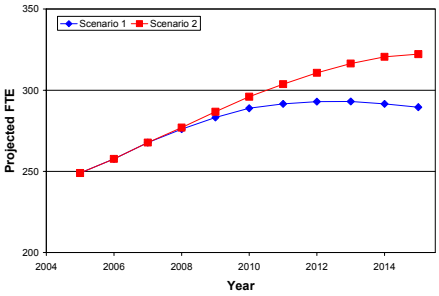
- The founding JILA Fellows have retired over the last decade
  - "Generational" turn over
  - Fellows median age has actually **dropped** by 10 years in last decade
  - Generally recognized that JILA has successfully renewed itself
- Energetic "youngsters" has led to expansion of JILA's size
  - mainly graduate student population

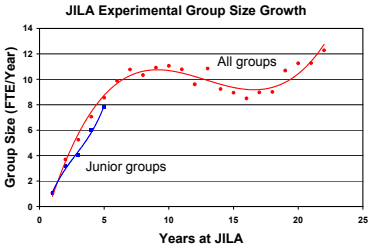




Space Crunch

- JILA is currently "full"
- However the "renewal" means there are many young groups
  - Likely to expand
- Predict future increase of 40-70 FTE
  - Based on historical group size trends
- Without an increase in space (quantity and quality), JILA risks loosing its best talent





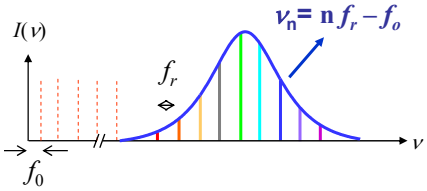
Proposed Solution

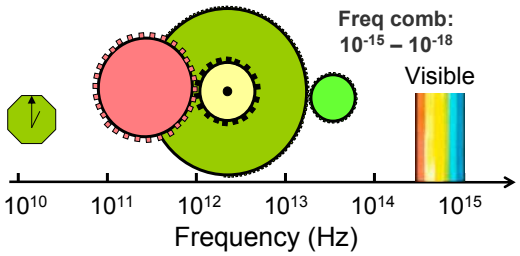
Tour Preview

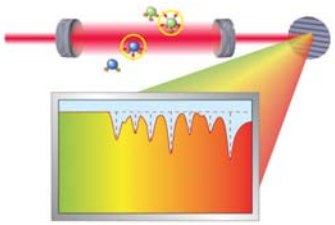
Frequency comb: state-of-the-art

JILA NIST CU

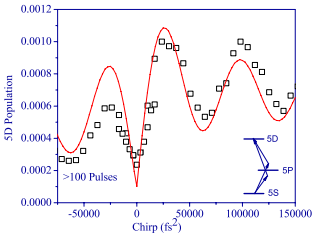
• Optical Synthesizer



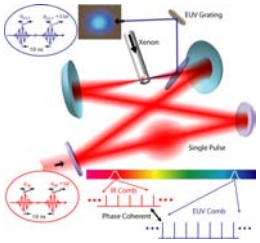




Molecular spectroscopy



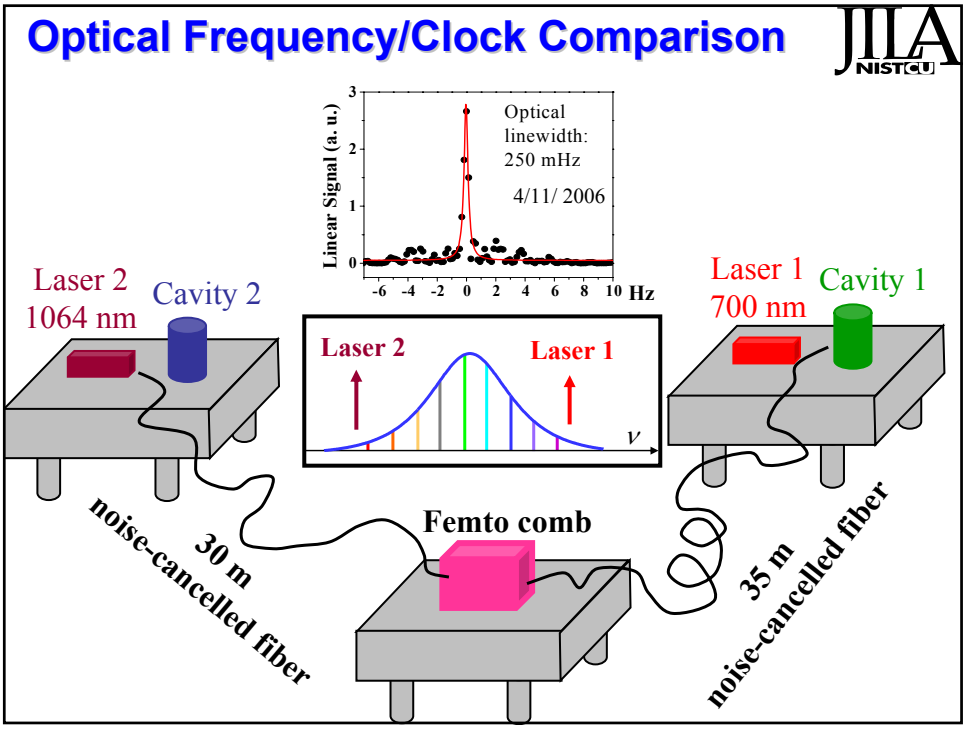
Quantum control



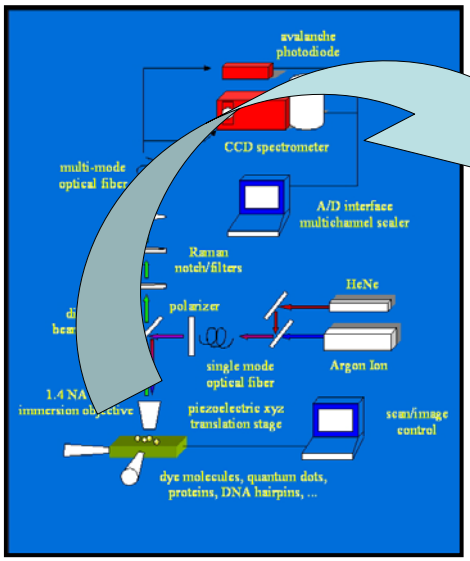
XUV comb

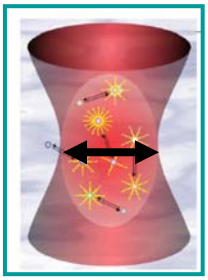
Optical Frequency/Clock Comparison

JILA NIST CU



Confocal Laser Microscopy



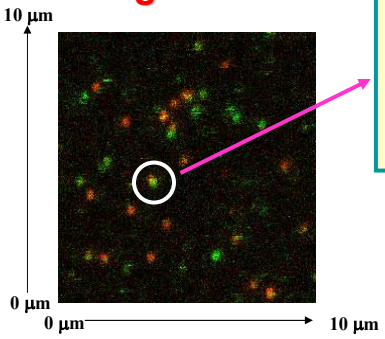


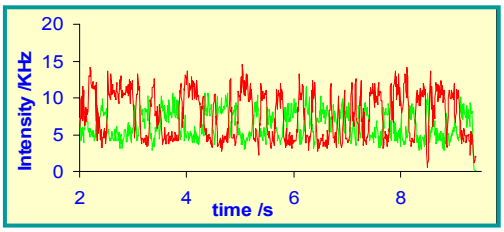
laser focus
200 nm

- Focus laser light to the diffraction limit (200 nm with 500 nm light)
- 0.1 *femtoliter* excitation volume
- For V = 10^{-16} liters and [conc] = 10^{-8} M, only 10^{-24} moles in volume
- $\Rightarrow$ Fewer than 1 molecule excited at a time

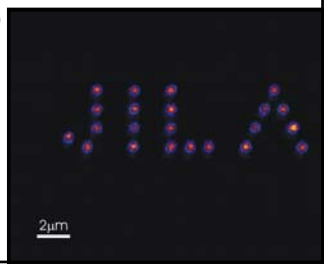
Applications of Confocal Microscopy

Single RNA Folding





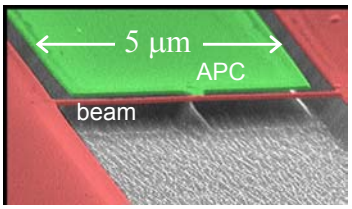
Laser writing of metal nanoparticles



Atomic Point Contacts

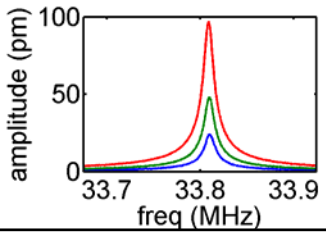
Sensors of Nanomechanical motion

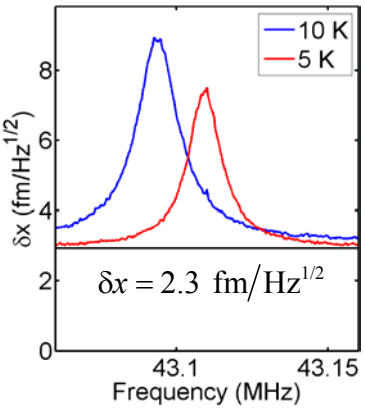
- Same principle as scanning tunneling microscope
- Exquisite sensitivity to nanomechanical motion
- Implement novel microwave measurement for order of magnitude speed increase



Actuate Beam with Electrostatic Force

- Suppress *intrinsic* shot-noise of tunneling electrons with active force feedback

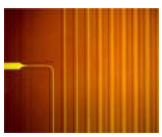




Measuring protein motions with femtosecond lasers

- Dynamics of heme proteins: cytochrome c & FixL

- Ligand binding & motions in CYP450



- Microfluidics for optical spectroscopy